PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-326379

(43)Date of publication of application : 12.12.1995

(51)Int.Cl. H01M 8/24

(21)Application number : 06-142457

(22)Date of filing : 31.05.1994

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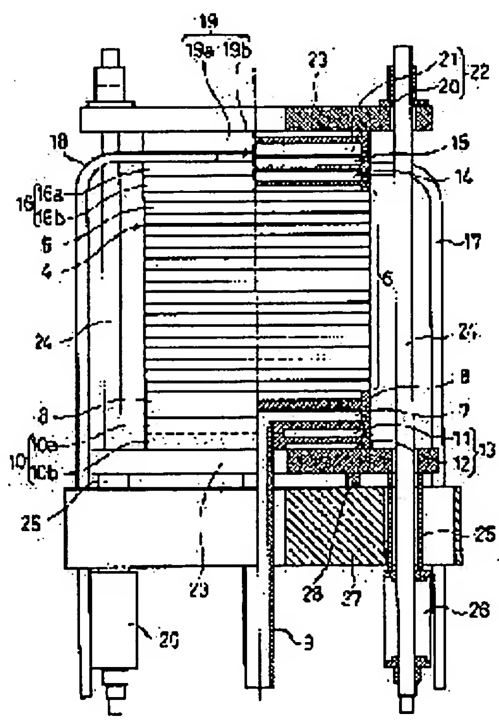
(54) STACKED FELL CELL

(57)Abstract:

PURPOSE: To reduce a temperature distribution difference between cells by providing an insulation layer at least on a lower plate, regarding plates positioned at the upper and lower ends of a cell stack body.



CONSTITUTION: The lower end of a cell stack body 6 in a stacking direction is provided with a bottom plate 8 forming a part of an anode exhaust gas buffer layer 7 for temporarily accumulating anode exhaust gas from the body 6 before the release thereof to the outside of a fuel cell. Also, a gas connector plate 10 is laid under the bottom plate 8 in such state as forming the anode gas buffer layer 7 together with the plate 8 as well as having external piping 9 for releasing anode exhaust gas from the buffer layer 7 to the outside of the fuel cell. An insulation layer 13 made of a vacuum layer 11 and an air layer 12 is formed on the connector plate 10 for preventing radiation toward the lower side of the cell stack body. According to this construction, heat conduction from the end of the cell stack body to a lower stack is hindered, and a temperature drop hardly occurs under the stack body.

LEGAL STATUS

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to temperature-distribution equalization of each cels in detail about the laminating mold fuel cell with which the laminating of two or more cels was carried out.

[0002]
[Description of the Prior Art] A fuel cell transforms the chemical energy supplied into electrical energy directly, in current, research of a phosphoric acid fuel cell, a fused carbonate fuel cell, a solid oxide fuel cell, etc. is done briskly, and high generating efficiency is expected. Generally this fuel cell is the structure where the laminating of two or more cels was carried out by turns through the separator. In the fuel cell of such a laminating mold, in order to attain the high increase in power of a cell, enlargement and high lamination of a cel are performed. However, if large-area-izing and high lamination of such a cel are performed, the difference of the temperature distribution between each cel in the direction of a laminating will become large. That is, although the thing near the center section of the direction of a cel laminating is in the condition of having been mutually kept warm by the ******** cel, among the cels by which the laminating is carried out and it is an elevated temperature, cel temperature will fall to the forge-fire exterior which goes to the direction upper limit of a laminating, or a lower limit that heat is easy to be taken.
[0003] If the difference of the temperature distribution between such cels arises, a difference will arise in the cell reaction in each cel, and the problem that a discharge property becomes an ununiformity or degradation of each cel takes place to an ununiformity will be produced. When a fuel cell is installed in a susceptor seat, the conductive heat is taken from this plinth section, and especially the lower part of a cell stack has a remarkable temperature fall.
[0004] As an approach of preventing the temperature fall of the lower part of such a cel layered product, you make it dotted with some spacers between a cel layered product and a plinth, it changes into the condition that the cel layered product floated from the plinth, and there is an approach heat conduction enables it not to happen easily. By the way, in the fuel cell of such a laminating mold, in order to lessen contact resistance inside a cell, it is necessary to contact the cel and separator of a cel layered product densely. For this reason, a cel layered product must be strongly bound tight in the direction of a laminating, and it is necessary to force a cel layered product to a plinth strongly. However, if a spacer is formed between a cel layered product and a plinth as mentioned above, a strong load will concentrate on several points of having formed the spacer, and the problem that a plinth is damaged will arise. Moreover, in order to secure the reinforcement of the plinth which can bear such a load, while inviting high cost-ization, since it leads to the eburnation of the ingredient of a plinth, thermal conductivity becomes high and will be in the condition which is not desirable for a temperature fall.
[0005] So, in the former, as usually shown in drawing 8 , it bound tight, with the plate 23 and the structure which the cel layered product 6 established up and down and which forms a spacer 28 between this bolting plate 23 and a plinth 27 is taken.
[0006]
[Problem(s) to be Solved by the Invention] However, also by the above-mentioned approach, the bolting plate carried out the duty of a radiation fin, and the heat loss from the lower part became a problem too. Moreover, the heat loss from the upper part is not solved, either. This invention is performed in view of the above-mentioned present condition, and it aims at offering a laminating mold fuel cell with few differences of the temperature distribution between cels.

[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, in invention of claim 1, it is characterized by preparing the thermal break which divides the heat transfer of the direction of a cel laminating on the plate with which two or more cels were prepared in said lower limit at least in the laminating mold fuel cell which has the plate prepared in the cel layered product by which the laminating was carried out, and the upper limit and lower limit of the direction of a cel laminating.
[0008] the reactant gas with which a plate according to claim 2 is supplied to a cel layered product in invention of claim 2 -- or -- It is characterized by forming the gas passageway which the reactant gas discharged from a cel layered product passes. In invention of claim 3, the thermal break of claim 2 is characterized by being prepared in the part outside said gas passageway, in view of a cel layered product.
[0009] In invention of claim 4, the thermal break of claims 1-3 is characterized by having an air space and/or a vacuum layer.
[0010]
[Function] By constituting as mentioned above, it acts as follows. In this invention, a thermal break is prepared in a lower plate at least among the plates located in the vertical edge of a cel layered product, cel laminating down heat conduction is prevented from the edge of a cel layered product by things, and the temperature fall of the lower part of a cel layered product stops being able to happen easily.
[0011] The heat loss from the upper part is also reduced by preparing the same thermal break also as the plate of upper limit. Moreover, an effective thermal break is especially formed by equipping the plate of an edge with a vacuum layer as a thermal break.
[0012]
[Example] The example concerning an example of this invention is explained referring to drawing 1 - drawing 6 .
(Example) The solid electrolyte fuel cell of the example which drawing 1 requires for an example of this invention is a cross-section side elevation a part, drawing 2 is the important section decomposition perspective view of an example, drawing 3 is the decomposition perspective view of the bottom plate seen from the upper part, and a gas connector plate, drawing 4 is the decomposition perspective view of the bottom plate seen from the lower part, and a gas connector plate, drawing 5 is the decomposition perspective view of the top plate seen from the upper part, and a gas connector plate, and drawing 6 is the decomposition perspective view of the top plate seen from the lower part, and a gas connector plate.
[0013] In addition, on the right-hand side of [center line] drawing 1 , it is I-I of drawing 2 . The outline sectional view is shown. Moreover, the flow of cathode gas and anode gas was shown by the arrow head. As shown in drawing 1 and 2, the solid electrolyte fuel cell of this example has the cel layered product 6 by which the 20-sheet laminating of the cel 4 (magnitude 15cmx15cm) which arranged the cathode 2 and the main surface anode 3 (un-illustrating) of another side on one main front face of an electrolyte plate 1 was carried out to the main front face through the bipolar plate 5 with which the cathode gas passageway and the anode gas path were formed of cutting. The bottom plate 8 which forms a part of anode exhaust buffer layer 7 once accumulated before the anode exhaust discharged from the cel layered product 6 to the direction lower limit side of a laminating of this cel layered product 6 is discharged by the fuel cell exterior is formed. Furthermore, under the bottom plate 8 concerned the exhaust gas discharge for emitting anode exhaust to the fuel cell exterior from this anode exhaust buffer layer 7 at the same time it forms the above-mentioned anode exhaust buffer layer 7 with the bottom plate 8 -- business -- the gas connector plate 10 to which the external piping 9 was connected is formed. Moreover, in order to prevent the heat dissipation to the lower part of a cel layered product, the thermal break 13 which consists of a vacuum layer 11 and an air space 12 is formed in this gas connector plate 10.
[0014] Moreover, before the anode gas which the cathode gas buffer layer 14 once accumulated was formed in the interior before the cathode gas supplied from the outside was supplied to the cel layered product, and was supplied to the upper limit side of the above-mentioned cel layered product 6 from the outside is supplied to a cel layered product, the top plate 16 which forms a part of anode gas buffer layer 15 once accumulated is arranged. in addition, the cathode gas supply for supplying cathode gas to a top plate 16 at the above-mentioned cathode gas buffer layer 14 -- business -- the external piping 17 is connected. the anode gas supply for forming the anode gas buffer layer 15 in the upper part of the top plate 16 concerned with a top plate 16 furthermore, and supplying anode gas to this anode gas buffer layer 15 -- business -- the gas connector 19 to which the external piping 18 was connected is formed. The thermal break 22 which becomes this gas connector plate 19 as well as the above-mentioned gas

connector plate 10 from the vacuum layer 20 and an air space 21 is formed.
[0015] The cell stack which has the above, the cel layered product 6, a top plate 16, the bottom plate 8, and the gas connector plates 10 and 19 minds the bolting plate 23 formed on the gas connector plates 10 and 19 or in the bottom, the bolting rod 24, and the bolting pipe 25, and is 0.5 - 4 kgf/cm2 to the direction of a laminating by the spring 26. It is bound tight with extent. Thus, the cell stack bound tight is installed in the condition of having floated with some spacers 28 on the plinth 27 which consists of a porous heat insulator.
[0016] Each configuration of the above-mentioned fuel cell is explained to below in more detail. The above-mentioned electrolyte plate 1 consists of yttria partially stabilized zirconia (3YSZ) 3%, a cathode 2 consists of perovskite mold oxide, such as lanthanum comics NETO, and an anode 3 consists of a nickel zirconia cermet. Furthermore, as an electrolyte plate 1 is shown in drawing 2 , from the cathode 2 and the anode 3 (un-illustrating), it is a large area and the periphery has extended in the method of outside [anode / 3 / a cathode 2 and]. On the electrolyte plate 1 of the method of outside [two electrodes / these], the internal manifold holes 1A, 1B, and 1C penetrated in the direction of a laminating are formed.
[0017] Moreover, the above-mentioned bipolar plate 5 consists of heat-resistant alloys, such as a nickel chrome alloy (for example, Inconel 600 and 601), and has a larger outer-diameter dimension a little than the above-mentioned electrolyte plate 1. As shown in drawing 2 , two or more ribs 51 which form a gas passageway are installed in the front face which meets the anode 3 of this bipolar plate 5 side by side, anode gas circulates to the Lord between each rib 51 in a crevice, and a cathode 2 is supplied. Moreover, the internal manifold holes 5A, 5B, and 5C are formed in the part which is on the bipolar plate 5 of the method of outside [part / of a rib 51 / formation], and is equivalent to the manifold holes 1A-1C of said electrolyte plate 1. The seal section 52 is formed in the perimeter of manifold hole 5A through which the perimeter of a bipolar plate 3 and card gas furthermore pass to an opposed face with the anode 3 of a bipolar plate 5.
[0018] On the other hand, the rib which serves as an anode gas path like an anode side opposed face is prepared in the opposed face with the cathode 2 of the bipolar plate 5 which is not illustrated, and the seal section is formed in the periphery of a bipolar plate 3, and the perimeter of the manifold holes 5B and 5C. In addition, it is prepared in the interior of the seal section of a cathode gas eject direction, the hole 53, i.e., the side-face exhaust port, for discharging cathode exhaust to the cell side.
[0019] Moreover, the above-mentioned bottom plate 8 is formed from Inconel 600. It gets down from the opposed face (refer to drawing 3) with the cel layered product 6 of this bottom plate 8 as **** the anode side of a cel, and the rib 81 which forms a gas passageway like the opposed face of the anode 3 of a bipolar plate 5 is formed. Manifold hole 8C is prepared in the location equivalent to manifold hole 5C furthermore prepared in the bipolar plate 5. However, the crevice 82 is formed in the location equivalent to manifold hole 1B of an electrolyte plate 1 so that Anouk Dos supplied from the upper part can flow into a gas passageway. Moreover, the seal section 83 is formed in the perimeter of this field.
[0020] The crevice 84 which becomes a part of anode exhaust buffer layer 7 of cathode exhaust which passed (drawing 4 reference) manifold hole 8C is formed in an opposed face with the gas connector plate 10 of the bottom plate 8, manifold hole 8C is located in the field of this crevice 84, and, as for the perimeter of this crevice, the seal section 85 is formed. Moreover, the above-mentioned gas connector plate 10 consists of Inconel 600, and consists of two plates 10a and 10b. Crevice 101a of the same configuration as the crevice 84 established in (refer to drawing 3) and the bottom plate 8 is prepared in an opposed face with the bottom plate 8 of plate 10a allotted to the bottom plate 8 side, and the anode exhaust buffer layer 7 is formed of the crevice 101a concerned and the crevice 81 of the bottom plate 8. this anode exhaust buffer layer 7 and fuel gas discharge -- business -- in order to connect the external piping 9 -- plate 10a -- fuel gas discharge -- business -- the anode exhaust which the external piping 9 is welded, was discharged from the cel layered product 6, passed manifold 8C, and flowed into this anode exhaust buffer layer 7 -- the above-mentioned fuel gas discharge -- business -- it is discharged outside by the external piping 9.
[0021] It is prepared in the opposed face with plate 10b of plate 10a in the form where two or more crevice 102a which forms a part of (refer to drawing 4) and vacuum layer 11 became independent. Crevice 101b of the same configuration as crevice 102a prepared in (refer to drawing 3) and plate 10a which counters is prepared in the opposed face with plate 10a of plate 10b, and space is formed of Crevices 102a and 101b by performing vacuum soldering, using a nickel wax as wax material for convex 103a prepared in the perimeter of each crevices 102a and 101b, and the 102b sections. This space serves as the vacuum layer 11 of the above-mentioned thermal break 13.

[0022] Furthermore, crevice 102b which became independent to some is prepared in the opposed face with the bolting plate plate 23 of 10b. When a cell is assembled, the space which binds tight with the crevice 102a concerned and is formed with a plate 23 serves as the air space 12 of a thermal break 13. in addition -- the center section of 10b -- anode exhaust external discharge -- business -- hole 103b which has a larger system than the path of the external piping concerned so that the external piping 9 can pass is prepared.
[0023] On the other hand, the gas connector plate 19 by the side of the cel layered product 6 upper part also consists of Inconel 600, and consists of two plates 19a and 19b. (Referring to drawing 5) and square crevice 191a are formed in the opposed face with the bolting plate 23 of plate 19a prepared in the bolting plate 23 side, and the space formed of the bolting plate 23 and this crevice 191a serves as the air space 21 of the above-mentioned thermal break 22.
[0024] Square crevice 192a which forms a part of (refer to drawing 6) and vacuum layer 20 is prepared in the opposed face with plate 19b of plate 19a. Crevice 191b of the same configuration as crevice 192of (drawing 5 referring-to) and plate 19a which counters a is prepared in the opposed face with plate 19a of plate 19b. By performing vacuum soldering, using a nickel wax as wax material for heights 193a prepared in the perimeter of each crevices 192a and 191b, and 192b, space is formed of crevice 192a and crevice 191b, and this serves as the vacuum layer 20 by them.
[0025] Moreover, crevice 192b which forms a part of (refer to drawing 6) and anode gas buffer layer 15 is prepared in the opposed face with the top plate 16 of plate 19b. When this crevice 192b assembles a cell, it is prepared to the field equivalent to the location in which manifold hole 1B which fuel gas passes is prepared. anode gas is supplied to the buffer layer of the anode gas furthermore formed in plate 19b of the above-mentioned crevice 192b -- as -- anode gas supply -- business -- the external piping 18 is welded. In addition, seal section 193b is formed in the perimeter of crevice 192b.
[0026] Moreover, the above-mentioned top plate 16 consists of Inconel 600, and is formed from two plates 16a and 16b. Crevice 161a of the same configuration as crevice 192of (drawing 5 referring-to) and 19b which counters b is prepared in the opposed face with plate 19b of plate 16a allotted to the gas connector plate 19 side, and manifold hole 16aB penetrated in the direction of a stack laminating is prepared in the location which is further equivalent to manifold 1B of the electrolyte plate 1 of this crevice 161a. Moreover, seal section 162a is formed in the perimeter of crevice 161a.
[0027] Where a fuel cell is assembled, space is formed of crevice 161of crevice 192b and plate 16a of plate 19b a. this space -- the anode gas buffer layer 15 -- becoming -- fuel gas supply -- business -- the anode gas supplied by the external piping 18 passes this anode gas buffer layer 15 and manifold hole 16aB, and is supplied in the cel layered product 6 direction.
[0028] Crevice 163a which forms a part is prepared in the opposed face with plate 16b of plate 16a in (refer to drawing 6) and the cathode gas buffer layer 14. However, this crevice 163a is prepared so that it may reach to the field equivalent to the location of manifold hole 1A of the electrolyte plate 1 which it is prepared so that the above-mentioned manifold hole 16aB may be located in a way outside crevice 163a, and cathode gas passes. Moreover, as for the perimeter of manifold hole 16aB, and the perimeter of crevice 163a, seal section 164a is formed.
[0029] cathode gas is supplied to the cathode gas buffer layer 14 furthermore formed of this crevice 162a -- as -- plate 16a -- oxidant gas supply -- business -- the external piping 17 is welded. Crevice 161b of the same configuration as crevice 163a prepared in (refer to drawing 5) and plate 16a which counters is prepared in the opposed face with plate 16a of plate 16b. Manifold hole 16bA penetrated in the direction of a cell laminating is prepared in the location which is equivalent to manifold hole 1A of an electrolyte plate 1 by this crevice 161b. Moreover, manifold hole 16bB is prepared in the location equivalent to manifold hole 16aB of plate 16a. Seal section 162b is formed in the perimeter of this manifold hole 16bB and crevice 161b.
[0030] The opposed face with the cel layered product 6 of plate 16b is countered the (drawing 6 referring-to) and cathode side of a cel, the cathode gas passageway is formed like the cathode side opposed face of a bipolar plate 5, and seal section 161b is formed in the perimeter of manifold hole 16bB through which the perimeter and anode gas of this field pass. Moreover, hole 162b for cathode gas discharge penetrated outside is prepared in the interior of the seal section of a cathode gas eject direction the interior side of a cel layered product.
[0031] In addition, the ingredient of a member used for bolting of a cell stack used heat-resistant metals, such as a nickel chrome alloy (Inconel 600 and 601), for the alumina and the bolting rod 24 at the bolting plate 23 and the bolting pipe 25. Furthermore, the alumina was used for the spacer. Moreover, heat-resistant metals, such as a nickel chrome alloy (Inconel 600 and 601), are used for the external

piping 9, 17, and 18.
[0032] It is welded to the connector plate. Furthermore, non-conductive hyperviscous melt like Pyrex glass was used for the gas seal of each seal part. By preparing the thermal break which becomes the bolting plate 23 and the ****** gas connector plates 10 and 19 which were described above from an air space and a vacuum layer, heat conduction to the bolting plate 9 is restricted, and the heat loss from an edge is reduced and turns into heat loss almost equivalent to a stack side face. Therefore, it is eased that the temperature of a stack vertical edge becomes low.
[0033] Moreover, by preparing an air space which was described above, and the thermal break which consists of a vacuum layer in a gas connector plate, the gas connector plate was able to become light and lightweight-ization of a fuel cell was also able to be attained. The solid electrolyte fuel cell of the above configurations is called A cell below.
(Example of a comparison) The laminating mold solid-state macromolecule fuel cell was produced like the above-mentioned example except forming the gas connector plates 91 and 92 with which the thermal break is not formed instead of the gas connector plate 10 of an example, and 19 as shown in drawing 8 . In addition, in drawing 8 , the above fuel cells which attach the jack per line are called X cell below to the same member as A cell.
(Experiment) Since the temperature of each bipolar plate, a bottom plate, and a top plate was measured in order to investigate the temperature distribution in the stack at the time of steady operation using A cell of an example, and X cell of the example of a comparison, the result is shown in drawing 7 . In addition, as a plate number in drawing 7 , 1-19, and a top plate set [the bottom plate] 0 and a bipolar plate to 20 from the downward cel in the upper part.
[0034] In addition, the thermocouple inserted in the interior of a plate from the measurement hole prepared in the side face of each plate performed the thermometry. Moreover, the conditions at the time of steady operation are the temperature near the cell stack of 1000 degrees C, current density 0.3 A/cm2, 30% of anode gas utilization factors, and 15% of rates of cathode gas utilization. If above [of the direction of a cel laminating] and downward cel temperature are measured so that clearly from drawing 7 , compared with the case of X cell shown with a broken line, temperature is [the direction of A cell shown as a continuous line] high. The thermal break which has an air space and a vacuum layer is prepared in the gas connector plate of this invention, heat conduction by the side of a bolting plate is checked by this thermal break, and this is considered that the fall of temperature was prevented.
[0035] Moreover, the cel temperature of a center section fell. Thereby, to the conventional X cell of the temperature gradient of the point of measurement inside a stack having been 58 degrees C, A cell of the example of this invention is 38 degrees C, and it turns out that the temperature between cells is also equalized.
(Other matters)
** the above-mentioned example -- the upper and lower sides of a cell stack -- although the thermal break was prepared in all, you may make it the configuration especially with an intense temperature fall prepared only in the lower part.
** Although the above-mentioned example showed the case where a fuel cell was an internal manifold mold, also in the fuel cell of an external manifold type, the same effectiveness is acquired by preparing a thermal break. In this case, a gas division plate and ******** next to each other are also good in the plate of another object which could make it the configuration which prepared the thermal break in the gas division plate prepared in the endmost part of the cell stack by which the laminating was carried out, and prepared the thermal break.
** It cannot restrict to what also described the configuration of a cel above, and can be adapted for all laminating mold fuel cells.
** In the above-mentioned example, although formed as a thermal break combining the vacuum layer and the air space, only an air space may be made into the structure of preparing only a vacuum layer.
[0036]
[Effect of the Invention] As explained above, according to this invention, the heat loss which happens from the lower part of a cel layered product is reduced by preparing a thermal break in the plate of a lower limit at least among the plates prepared in the upper limit of a cel layered product, and a lower limit. As a result, it is mitigated, and the difference of the temperature distribution between the cels of a cel layered product can attain equalization of the property of a cel, as a result leads to the reinforcement of a cel.